

CLADOCERA RECORDED FROM AUSTRALIA

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Summary

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One hundred and sixty-five taxa of Cladocera, in 53 genera, are recognized from Australia. Seventy-two of these are endemic, with another five also recorded from New Zealand. Species names, with published synonymy, are listed systematically. Distributions are given by State/Territory only.

KEY WORDS: Crustacea, Branchiopoda, Anomopoda, Ctenopoda, cladocerans, Australia, checklist, taxonomy, distribution.

Introduction

The small branchiopod crustaceans commonly called cladocerans are vital links in aquatic food webs as intermediate grazers between algae and bacteria and higher order consumers, e.g. macroinvertebrates and fish. They generally have been neglected in Australian ecological studies, in part because of the lack of suitable local taxonomic references or expertise.

The first brief descriptions of Australian cladocerans appeared in the expedition reports of Dana (1852, 1853), with more detailed descriptions of peculiarly Australian cladocerans by King (1853, 1854, 1866), from the neighbourhood of Sydney. Later, G.O. Sars (e.g. 1885, 1888, 1889, 1896, 1897), working in Norway, described specimens raised from dried mud mailed to him from Australia. Subsequent incidental records, e.g. Henry (1919, 1922), Gurney (1927), Serventy (1929), Brehm (1953a, b), Petkovski (1973a, b) brought to ca. 60 the taxa of cladocerans known from Australia.

Early records were collated, and new taxa described, by Smirnov & Timms (1983), in the first revision of the Australian Cladocera. They listed 125 taxa, and provided keys and figures for most of them. Subsequently, significant taxonomic changes were made (e.g. Benzie 1988; Korovchinsky 1992) and a further 45 cladocerans were described (e.g. Frey 1991a, b; Sergeev 1990a, b; Sergeev & Williams 1985; Smirnov 1989a, b, 1992). Five additional indigenous chydorid taxa are described in manuscripts only partly completed by the late D. G. Frey (Indiana University). Frey was working on Gondwanan chydorids, with emphasis on the radiation of the family in Australia, when he died in 1992.

Particularly as a result of Frey's highly detailed work, it has become apparent that many of the cladocerans recorded from Australia, but described from elsewhere,

are not conspecific with the nominate species. The wide dissemination of authoritative (albeit northern hemisphere) taxonomic references is partly to blame, compounded by lack of careful discrimination. Also, possibly as a consequence of the widespread acceptance of cosmopolitanism, some earlier authors did not figure their finds, but merely listed them. It is thus impossible to determine the true identity of an animal if the description is minimal, there are no figures, or the original material has been lost.

Our intention in providing a checklist of the cladocerans recorded from Australia is to bring together a disparate and often inaccessible literature. The listing below is a starting point and includes all the taxa and references which have appeared since the revision by Smirnov & Timms (1983). We stress that it is our opinion that at least some of the taxa named are not conspecific with the nominate species, particularly those described initially from the northern hemisphere. It will clearly take considerable effort to resolve the systematic uncertainties.

Systematics

We continue to use "Cladocera" because it is familiar, although the term no longer has taxonomic significance. The classification of the Crustacea, Branchiopoda is outlined by Dodson & Frey (1991). Most Australian cladoceran families are placed in the Anomopoda (families Daphniidae (5 genera/21 species), Moinidae (2/7), Bosminidae (2/2), Ilyocryptidae (1/4), Macrothricidae (5/24) and Chydoridae (29/101)). Only one of the two families in Ctenopoda occurs here - Sidae (5/11), the Holopedidae do not. Similarly, only one of the three families in Onychopoda occurs here - Podonidae (marine, 4/5). The Polyphemidae and Cercopagidae are not recorded here. Neither are the Haplopoda: Leptodoridae known from Australia. This zoogeographic disparity is significant

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ecologically; these absent families contain the larger carnivorous cladocerans.

Cladocera recorded from Australia

In the following checklist, all genera and species of cladocerans recorded from Australia are listed alphabetically in their respective families. Original authors are cited fully in the reference list to facilitate location of original descriptions. See also references cited by Hawking (1994) and Shiel (1995). The first recorded Australian locality follows the describing author, with subsequent finds outside the State/Territory of first record also given with citing author(s). To minimize repetitive citation, exhaustive listings of later finds in the same State/Territory are not given. Published synonymies or reassignments relevant to the Australian fauna also are given, as are authors of synonymy. In the following list, * = endemic to Australia, ** = Australia and New Zealand. A "?" with the locality record indicates that the taxon was listed with a "cf." and is not positively identified from that State/Territory. Unless specifically noted, all records are from Australian inland waters, both fresh and athalassic saline. Families are treated systematically in the sequence as given by Smirnov & Timms (1983). However, the *Ilyocryptus* species are separated into the family Ilyocryptidae as proposed by Smirnov (1992). For convenience genera and species within each family are listed alphabetically. In the author citations, two authors who are sometimes confused are separated as follows: (O.F.) Müller, with umlaut, who published in the late 1770s-80s and (P.E.) Mueller, with ue, who published in the 1860s.

Family Sididae Baird, 1850

- Diaphanosoma* Fischer, 1850
 **D. australiensis* Korovchinsky, 1981; Qld (Korovchinsky 1981). Later finds all in Qld
D. excisum Sars, 1885; Qld (Sars 1885); NSW (Jolly 1966); SA (Shiel *et al.* 1982); NT (Tait 1982¹); WA (Timms 1988)
D. sarsi Richard, 1894; Qld (Korovchinsky 1981); NT (Tait *et al.* 1984); WA (Timms 1988)
 **D. unguiculatum* Gurney, 1927; Qld (Gurney 1927); Vic., NSW (Walker & Hillman 1977); SA (Shiel *et al.* 1983); NT (Tait 1982¹); WA (Brock & Shiel 1983); ?Papua-New Guinea (Korovchinsky 1992)
D. volzi Stingelin, 1905; NSW (Korovchinsky 1981)

Latonopsis Sars, 1888

- L. australis* Sars, 1888; Qld (Sars 1888); Vic., NSW (Shiel 1978); NT (Jull 1986); WA (Timms 1988)
 **L. brehmi* Petkovski, 1973; WA, NSW (Petkovski 1973b); NT (Jull 1986); Qld (Timms 1986)

Penilia Dana, 1852

- P. avirostris* Dana, 1852; NSW (marine, coastal) (Dakin & Colefax 1940)

Pseudosida Herrick, 1884

- **P. australiensis* Smirnov & Timms, 1983; NSW (Korovchinsky, in Smirnov & Timms 1983)
P. szalayi Daday 1898; Qld, NT, WA (Timms 1988)
Sarsilatona Korovchinsky, 1985

- S. papuana* (Daday, 1901); *Pseudosida papuana* Daday, 1901; *Sarsilatona papuana*: Korovchinsky (1985); NT (Korovchinsky 1985); Qld, WA (Timms 1988)

Family Podonidae Mordukhai-Boltovskoi, 1968

Pleopsis Dana, 1852

- P. polyphemoides* (Leuckart, 1859); E. Australia (marine) (Dakin & Colefax 1940)

Pseudevadne (Claus, 1877)

- P. tergestina* (Claus, 1877); E. Australia (marine) (Dakin & Colefax 1940)

Podon Lilljeborg, 1853

- P. internedius* Lilljeborg, 1853; Vic. (estuarine) (Neale & Bayly 1974)

Evadne Loven, 1836

- E. spinifera* Mueller, 1867; E. Australia (marine) (Dakin & Colefax 1940)
E. nordmanni Loven, 1836; E. Australia (marine) (Dakin & Colefax 1940)

Family Chydoridae Stebbing, 1802

Acroperus Baird, 1843

- A. ulanoides* Hudendorff, 1876; NSW (Smirnov 1971); Qld (Timms 1988)

- A. harpae* (Baird, 1834); *Lynceus harpae* Baird, 1834; *Acroperus harpae*: Baird (1843); NSW (Smirnov 1971)

- A. neglectus* Lilljeborg, 1900; *Acroperus avirostris* Henry, 1919; Smirnov & Timms (1983); NSW (Henry 1919)

- **A. sinuatus* Henry, 1919; NSW (Henry 1919)

Alona Baird, 1843

- A. archeri* Sars, 1888; Qld (Sars 1888)

- **A. beverleyae* Smirnov, 1989; Qld (Smirnov 1989a)

- A. cambouei* Guerne & Richard, 1893; NSW (Henry 1919); Vic. (Shiel 1976); Qld, NT, WA (Timms 1988)

- **A. clathrata* Sars, 1888; Qld (Sars 1888); NSW (Henry 1922)

- A. costata* Sars, 1862; NSW (Smirnov 1971); Vic. (Timms 1973²); NT (Tait 1982¹)

¹TAIT, R. D. (1982) Plankton of Magela billabongs, N.T. M.Sc. thesis, Macquarie University, unpubl.

²TIMMS, B. V. (1973) A comparative study of the limnology of three maar lakes in western Victoria. Ph.D. Thesis, Monash University, unpubl.

- A. crassicaudata* Sars, 1916; Qld, NT, WA (Timms 1988)
- A. diaphana* King, 1853: *Alonella diaphana* (King): Sars (1888); *Alona davidi* Richard, 1895: Frey (1991a); *Alona davidi* var. *iheringi* Richard, 1897: Frey (1991a); *Alona punctata* Daday, 1898: Frey (1991a); see Frey (1991a) for comments on synonymy; NSW (King 1853); Qld (Sars 1888); Vic. (Shiel 1976); SA (Shiel 1981³); NT (Tait *et al.* 1984); WA (Timms 1988)
- A. guttata* Sars, 1862; *Alona microrata* Henry, 1922: Smirnov & Timms (1983); NSW (Henry 1922); Vic. (Timms 1973²); SA (Shiel *et al.* 1982); NT (Tait *et al.* 1984); Qld, WA (Timms 1988)
- A. inreticulata* Shen Chia-jui, Sung Ta-hsiang & Chen Kuo-hsiao, 1964; Vic. (Morton & Bayly 1977); Tas. (Smirnov & Timms 1983)
- **A. investis* Smirnov & Timms, 1983; Vic. (Smirnov & Timms 1983)
- **A. laevissima* Sars, 1888; Qld (Sars 1888); NSW (Henry 1922)
- **A. macracantha* Smirnov & Timms, 1983; NSW (Smirnov & Timms 1983)
- A. monacantha* Sars, 1901; NT (Julli 1986); Qld (Timms 1988)
- A. poppei* Richard, 1897; Vic. (Shiel 1981³)
- A. pulchella* King, 1853; NSW (King 1853); Vic. (Shiel 1981³); ?Qld, NT, WA (Timms 1988)
- A. quadrangularis* (Müller, 1785); *Lynceus quadrangularis* Müller, 1785; *Alona quadrangularis*: Smirnov (1971); Vic., WA (Smirnov & Timms 1983)
- A. rectangularis* Sars, 1862; Qld, SA (Smirnov 1971); Vic. (Shiel 1976); NSW (Walker & Hillman 1977); NT, WA (Timms 1988)
- **A. setuloides* Smirnov & Timms, 1983; WA (Smirnov & Timms 1983)
- A. striolata* Sars, 1916; "tropical Australia" (Smirnov 1989a)
- **A. truncata* Smirnov, 1989; Qld (Smirnov 1989a)
- **A. unguiculata* Smirnov, 1989; Qld (Smirnov 1989a)
- Alonella* Sars, 1862
- A. elathranula* Sars, 1896; NSW (Sars 1896); SA (Shiel 1981³); NT (Julli 1986); Qld (Timms 1986); WA (Timms 1988)
- A. excisa* (Fischer, 1854); *Lynceus excisus* Fischer, 1854; *Alonella excisa*: Sars 1862b; NSW (Henry 1922); Vic. (Shiel 1976); SA (Shiel 1981³); Qld (Hawkins 1988); ?WA (Bayly 1992)
- A. exigua* (Lilljeborg, 1853); *Lynceus exiguus* Lilljeborg, 1853; *Alonella exigua*: Mueller, 1867; NSW (Smirnov 1971); NT (Tait *et al.* 1984)
- **Archepleuroxus* Smirnov & Timms, 1983
- **A. baylyi* Smirnov & Timms, 1983; Vic., Tas., WA (Smirnov & Timms 1983)
- **Australochydorus* Smirnov & Timms, 1983
- **A. aporus* Smirnov & Timms, 1983; Qld, NSW (Smirnov & Timms 1983); NT (Tait *et al.* 1984); WA (Timms 1988)
- Biapertura* Smirnov, 1971
- **B. abbreviata* (Sars, 1896); *Alona abbreviata* (sic) Sars, 1896; *Biapertura abbreviata* (sic): Smirnov & Timms 1983; NSW (Sars 1896)
- Comment: The spelling of the species name with a single b as *abbreviata* in the original description (Sars 1896; 40) appears to be a typographical error, as it is later spelt (p. 43 text; p. 79 fig. caption) as *abbreviata*.
- B. affinis* (Leydig, 1860); *Lynceus affinis* Leydig, 1860; *Alona whiteleggii* Sars, 1896; Henry 1922; *Alona affinis*: Sars 1901; *Alona longirostris* Henry, 1919; Smirnov 1971; *Biapertura affinis*: Smirnov & Timms 1983; NSW (Sars 1896); Vic. (Timms 1973²); WA (Williams 1979); SA (Shiel 1981³); NT (Tait 1982¹); Qld (Timms 1986)
- **B. duodonta* (Henry, 1922); *Alonella duodonta* Henry, 1922; *Biapertura duodonta*: Smirnov & Timms 1983; NSW (Henry 1922) ?NT (Tait *et al.* 1984)
- **B. imitatoria* Smirnov, 1989; WA (Smirnov 1989a)
- B. intermedia* (Sars, 1862); *Alona intermedia* Sars, 1862; *Biapertura intermedia*: Smirnov 1971; Qld (Gurney 1927); NSW (Smirnov 1971); Vic. (Shiel 1978); WA (Bayly 1982); NT (Timms 1988)
- B. karua* (King, 1853); *Alona karua* King, 1853; *Alonella karua*: Sars, 1888; *Biapertura karua*: Smirnov & Timms 1983; NSW (King 1853); Qld (Sars, 1888); Vic. (Morton 1973⁴); NT (Tait 1982¹); WA (Timms 1988)
- Comment: King's description is inadequate by modern standards. There are differences in the post-abdomen morphology of his species and that later hatched from Qld mud by Sars (1888), although Sars considered the taxa identical. There is now good evidence that *B. karua* represents a species complex worldwide (Alonso & Pretus 1989). In our opinion the 1000 km separation of the King and Sars taxa is sufficient to doubt conspecificity, hence their respective identities are not satisfactorily resolved at this time. The problem is compounded by errors in Smirnov & Timms (1983) (see *Incertae sedis* below).
- **B. kendallensis* (Henry, 1919); *Alona kendallensis* Henry, 1919; *Biapertura kendallensis*: Smirnov 1971; NSW (Henry 1919); Qld (Smirnov 1971); Vic. (Timms 1973²); NT (Julli 1986); WA (Gröwus *et al.* 1992)

³Simu, R. J. (1981) Plankton of the Murray-Darling river system, with particular reference to the zooplankton. Ph.D. Thesis, University of Adelaide, unpubl.

⁴Morton, D. W. (1973) Studies on some temporary Victorian waters with special reference to the Microcrustacea. B.Sc. (Hons) Thesis, Monash University, unpubl.

- **B. longiqua* Smirnov, 1971; NSW, Qld (Smirnov 1971); Vic. (Shiel 1981³); WA (Timms 1988)
- **B. macrocopa* (Sars, 1894): *Alona macrocopa* Sars, 1894; *Biapertura macrocopa*: Smirnov & Timms 1983 (author date given as 1895); Qld (Gurney 1927); Vic. (Morton & Bayly 1977); WA (Bayly 1982); NSW (Timms 1982)
- **B. rigidicaudis* Smirnov, 1971; *Alona intermedia*: Gurney 1927 (misidentification); *Biapertura rigidicaudis*: Smirnov 1971; Qld (Gurney 1927); Vic. (Shiel 1976); NSW (Timms 1976); SA (Shiel 1981³); WA (Bayly 1982); NT (Jull 1986)
- **B. rusticoides* Smirnov & Timms, 1983; Tas. (Smirnov & Timms 1983)
- B. setigera* (Brehm, 1931); *Alona gattana setigera* Brehm, 1931; *Alona setigera*: Petkovski 1973a; *Biapertura setigera*: Smirnov & Timms 1983; NSW (Bayly 1970); Vic. (Shiel 1976); SA (Shiel 1981³); Qld (Timms 1986) ?WA (Storey *et al.* 1993)
- B. verrucosa* (Sars, 1901); *Alona verrucosa* Sars, 1901; *Alona rectangula pulchra* Hellich, 1874; Smirnov 1971 and Smirnov & Timms 1983; *Biapertura verrucosa*: Smirnov 1989; Qld (Smirnov 1971); NT (Jull 1986); WA (Timms 1988)
- **B. willsi* Smirnov, 1989; Qld (Smirnov 1989)
- Camptocercus* Baird, 1843
- ***C. australis* Sars, 1896; NSW (Sars 1896); Vic. (Shephard *et al.* 1918); Qld (Smirnov 1971); NT (Tait 1982¹); WA (Timms 1988)
- **Celstinotum* Frey, 1991
- **C. hypsilopham* Frey, 1991; NSW (Frey 1991a)
- **C. parooensis* Frey, 1991; NSW (Frey 1991a)
- **C. platamodes* Frey, 1991; NSW (Frey 1991a)
- Chydorus* Leach, 1816
- C. eurynotus* Sars, 1901; Qld (Timms 1967); Vic. (Walker & Hillman 1977)
- C. herrmanni* Brehm, 1933; Qld (Timms 1967); Vic. (Shiel 1981³)
- C. kallipygos* Brehm, 1933; NSW (Petkovski 1973a); Qld (Hann 1975⁵)
- Comment: Smirnov & Timms (1983) regarded Petkovski's record as a misidentification of *C. eurynotus*. However Hann (1975⁵) independently recorded *C. kallipygos* from NSW and Qld. Petkovski's record should stand until a thorough revision of the genus is made.
- **C. obscurirostris* Frey, 1987; NT, WA (Frey 1987)
- **C. opacus* Frey, 1987; NT, Qld, WA (Frey, 1987)
- C. parvus* Daday, 1898; "tropical Australia" (Smirnov 1989a)
- C. pubescens* Sars, 1901; NT, Qld, WA (Timms 1988)
- C. reticulatus* Daday, 1898; "tropical Australia" (Smirnov 1989a)
- Comment: This species was listed without comment by Smirnov (1989). It is given as a synonym of *C. sphaericus* (Müller) in Flössner (1972). The relationship of this taxon to the other 'faviformis-like' reticulated taxa described by Frey (1987) remains unresolved. We consider it unlikely to be Daday's species.
- C. sphaericus* (Müller, 1785); *Lynceus sphaericus* Müller, 1785; *Chydorus sphaericus*: Baird 1843; *Chydorus clelandi* Henry, 1919 was synonymized with *Chydorus leonardi* by Henry (1922); *Chydorus leonardi* King, 1853; Smirnov (1971) *C. leonardi* was attributed to Sars, 1896 by Smirnov & Timms (1983); NSW (King 1853); Vic. (Morton 1967); Qld (Timms 1967); NT (Tait 1982¹); SA (Shiel *et al.* 1982); ?WA (Bayly 1992)
- Comment: In view of the restricted distribution of *Chydorus sphaericus* s. str. (Frey 1980), it is likely that a complex of species occurs in Australia, none of which is the nominate taxon (D.G. Frey pers. comm.)
- Dadaya* Sars, 1901
- D. macrops* (Daday, 1898): *Alona macrops* Daday, 1898; *Dadaya macrops*: Sars 1901; Qld (Smirnov 1971); NT (Tait *et al.* 1984); WA (Timms 1988)
- Disparalona* Fryer, 1968
- D. acutirostris* (Birge, 1879); *Pleuroxus acutirostris* Birge, 1879; *Almella acutirostris*: Frey 1959; *Disparalona acutirostris*: Fryer 1971; "tropical Australia" (Smirnov 1989a)
- Dunhevedia* King, 1853
- D. crassa* King, 1853; NSW (King 1853); Qld (Sars 1888); SA (Henry 1922); Tas. (Brehm 1953a); Vic. (Morton 1973⁴); NT (Tait *et al.* 1984); WA (Timms 1988)
- Ephemeroporus* Frey, 1982
- E. tridentatus* (Bergamin, 1939); *Chydorus tridentatus* Bergamin, 1939; *Chydorus barrovi* Richard, 1894; Fig. 329 in Smirnov 1971; *Ephemeroporus tridentatus*: Frey 1982a; Qld (Smirnov 1971); Vic. (Shiel 1981³); NT (Tait *et al.* 1984); WA (Timms 1988)
- Comment: see *Incertae sedis* for other taxa referred to this genus in Australia.
- Euryalona* Sars, 1901
- E. orientalis* (Daday, 1898); *Alonopsis orientalis* Daday, 1898; *Euryalona occidentalis* Sars, 1901; Smirnov 1971; *Euryalona orientalis*: Daday 1905; Qld (Smirnov & Timms 1983); NT (Tait *et al.* 1984); WA (Timms 1988)
- Graptoleberis* Sars, 1862
- G. testudinaria* (Fischer, 1848); *Lynceus testudinarius* Fischer, 1848 (cited as 1851 in Smirnov & Timms [1983]); *Graptoleberis testudinaria*: Kurz, 1874; NSW (Henry 1919); Vic. (Shiel 1976); NT (Tait 1982¹); Qld, WA (Timms 1988)

⁵HANN, B. J. (1975) Taxonomy of Chydoridae in Ontario and genus *Chydorus* worldwide. MSc. Thesis, University of Waterloo, Ontario, unpubl.

Kurzia Dybowski & Grochowski, 1894

K. latissima (Kurz, 1874); *Alonopsis latissima* Kurz, 1874; *Kurzia latissima* Dybowski & Grochowski 1894; Vic. (Shiel 1976)

K. longirostris (Daday, 1898); *Alona longirostris* Daday, 1898; *Kurzia longirostris*: Harding 1957; NSW (Timms 1972); NT (Tait *et al.* 1984); Qld, WA (Timms 1988)

**Leberis* Smirnov, 1989

**L. aenigmata* Smirnov, 1989; WA (Smirnov 1989b)

Leydigia Kurz, 1874

L. acanthocercoides (Fischer, 1854); *Lynceus acanthocercoides* Fischer, 1854; *Leydigia acanthocercoides*: Kurz, 1874; NSW (Timms 1970), NT (Jull 1986); Qld, WA (Timms 1988)

L. australis Sars, 1885; Qld (Sars 1885); NSW (Shiel 1978); Vic., SA (Shiel 1981³)

L. ciliata Gauthier, 1939; NSW, Qld (Smirnov 1971); Vic. (Shiel 1981³)

**L. laevis* Gurney, 1927; Qld (Gurney 1927); NSW (Shiel 1981³); WA (Growth *et al.* 1992)

L. leydigi (Schoedler, 1863); *Alona leydigi* Schoedler, 1863; *Leydigia leydigi*: Daday 1902; SA (Henry, 1922); Vic. (Shiel 1976); NT (Tait 1982¹); WA (Growth *et al.* 1992); NSW (Kobayashi 1992)

**Monope* Smirnov & Timms, 1983; *Monoporus* Smirnov, 1977; Smirnov & Timms (1983: 34)

**M. reticulata* (Henry, 1922); *Pleuroxus reticulatus*: Henry 1922; *Monoporus henryae* Smirnov, 1977; *Monope reticulata*: Smirnov & Timms 1983; non *Pleuroxus reticulatus* Henry, 1918; Frey 1991b; NSW (Henry 1922); WA (Bayly 1992)

Comment: Henry's (1918) taxon as figured is, according to Frey (1991b), a species of *Alonella*, probably *A. clathranula* Sars, 1896.

Monospilus Sars, 1862

**M. diporus* Smirnov & Timms, 1983; SA (Shiel 1978) (as *Monospilus* sp. nov.); WA (Brock & Shiel 1983) (as *Monospilus* sp.); NSW (Shiel 1981³) (as *Monospilus* n. sp. 1); Vic. (Shiel & Croome, unpubl. data)

**M. elongatus* Smirnov & Timms, 1983; SA (Shiel 1981³) (as *Monospilus* n. sp. 2)

Comment: Neither of these taxa is referable to *Monospilus* s. str.; indeed they are probably not even congeneric (D.G. Frey, pers. comm.).

Notoalona Rajapaksa, 1986

N. globulosa (Daday, 1898); *Alona globulosa* Daday, 1898; *Notoalona globulosa*: Rajapaksa & Fernando 1987. The nominate species is not recorded from Australia. However a geographic subspecies is known:

**N. globulosa australiensis* (Rajapaksa & Fernando, 1987); *Indialona* (Petkovski, 1966); Rajapaksa & Fernando 1987; NT (Smirnov & Timms 1983 as

Indialona sp.); Qld (Rajapaksa & Fernando 1987); WA (Timms 1988)

Comment: *Indialona* was reported from the NT by Smirnov & Timms (1983), species not given. Jull (1986) reported *I. globulosa*, also from the N.T. As Rajapaksa & Fernando obtained their material from B.V. Timms, who also collected the Smirnov & Timms material and identified the Jull material, it is probable that all N.T. records are *N. globulosa australiensis*.

Oxyurella Dybowski & Grochowski, 1894

O. singalensis (Daday, 1898); *Alonopsis singalensis* Daday, 1898; *Oxyurella singalensis*: Smirnov 1971; Qld (Smirnov & Timms 1983); NT (Jull 1986); WA (Timms 1988)

O. tenuicaudis (Sars, 1862); *Alona tenuicaudis* Sars, 1862; *Alona wallaciana* Henry, 1919; *Oxyurella wallaciana*: Smirnov 1971; *Oxyurella tenuicaudis*: Smirnov & Timms 1983; NSW (Henry, 1919); ?Vic. (Timms 1973⁷) (as *Oxyurella* sp.)

**Planicirelas* Frey, 1991

**P. alticarinatus* Frey, 1991; WA (Frey 1991b)

**Plurispina* Frey, 1991

**P. chauliodis* Frey, 1991; WA (Frey 1991b)

**P. multinuberculata* Frey, 1991; WA (Frey 1991b)

Pleuroxus Baird, 1843

**P. joveatus* Frey, 1991; WA (Frey 1991b)

**P. inermis* Sars, 1896; *Chydorus denticulatus* Henry, 1919; Frey (1991b); NSW (Sars 1896); Vic. (Haase 1903); ?Qld (Gurney 1927); SA (Shiel 1981³); WA (Bayly 1992)

**P. jugosus* (Henry, 1922); *Chydorus jugosus* Henry, 1922; Smirnov & Timms (1983); NSW (Henry 1922)

Comment: Frey (1991b) states that close study of the type specimen did not reveal enough positive characters to make a firm decision (regarding *Pleuroxus* cf. *jugosus*), and hence this taxon, at least for the present, must be regarded as a *nomen dubium*. *Pleuroxus jugosus* in Smirnov & Timms (1983) is not *Chydorus jugosus* Henry, 1922; rather most of the description and all of the illustrations in this paper are for *Plurispina chauliodis* Frey, 1991.

**P. kakaduensis* Smirnov, 1989; NT (Smirnov 1989b)

P. laevis Sars, 1862; NT, Qld, WA (Timms 1988)

P. similis Vavca, 1900; *P. australis* Henry, 1922; Smirnov & Timms 1983; NSW (Henry 1922)

Comment: Probably absent from Australia (Frey 1991b)

**P. tricolatus* Smirnov, 1989; WA (Smirnov 1989b)

Pseudochydorus Fryer, 1968

P. globosus (Baird, 1843); *Chydorus globosus* Baird, 1843; ?*Chydorus augustus* King, 1853; Sars (1888); *Pseudochydorus globosus*; Fryer 1968; ?NSW (King 1853); Vic. (Shepherd *et al.* 1918); Qld (Timms & Midgley 1969); SA (Smirnov 1971); NT, WA (Timms 1988)

Rak Smirnov & Timms, 1983

**R. labrosus* Smirnov & Timms, 1983; SA, Tas, Vic, WA (Smirnov & Timms 1983)

**R. obtusus* Smirnov & Timms, 1983; NSW, WA (Smirnov & Timms 1983); Qld (Timms 1988)

Comment: Several new species of *Rak* from W.A., are included in an incomplete MS by the late D.G. Frey. He also found *Rak* in South Africa.

The *Rak* MS will be completed by RJS.

**Rhynchochylorus* Smirnov & Timms, 1983

**R. australiensis* Smirnov & Timms, 1983, *Amblyorhynchus*: Bayly 1992 (*nomen nudum*); NSW (Smirnov & Timms 1983); WA (Bayly 1992)

***Saycia* Sars, 1904

***S. cooki* (King, 1866); *Eurycercus cooki* King, 1866; *Saycia orbicularis* Sars, 1904; Smirnov 1966; *Saycia cooki*: Smirnov 1966; NSW, Qld (King 1866); Vic. (Sars 1904)

Comment: After examining a N.Z. population, Frey (1971) concluded that it represented a new geographic subspecies, *Saycia cooki novaezealandiae* Frey, 1971. The Australian subspecies is designated *Saycia cooki cooki* (King, 1866): Smirnov & Timms 1983.

Family Hyocryptidae Smirnov, 1992

Hyocryptus Sars, 1862

I. brevidentatus Ekman, 1905; Vic. (Shiel 1981³), NT (Tait *et al.* 1984)

**I. raridematus* Smirnov, 1989; WA (Smirnov 1989b)

I. sordidus (Lievén, 1848); *Acanthocercus sordidus* Lievén, 1848; *Hyocryptus sordidus*: Sars 1896; NSW (Sars 1896); Vic. (Henry 1922); SA (Shiel 1981³); NT (Tait *et al.* 1984)

I. spinifer Herrick, 1882; *I. longiremis* Sars, 1888; Smirnov & Timms (1983); *I. halyi* Brady, 1886 in Gurney (1927); Smirnov & Timms (1983); Qld (Sars, 1888); ?Vic. (Timms 1973); WA (Williams 1979); SA, NSW (Shiel 1981³); NT (Julli 1986)

Family Macrothricidae Baird, 1843

Grimaldina Richard, 1892

G. brazzai Richard, 1892; Qld, NT (Timms 1988)

Macrothrix Baird, 1843; *Echinisca* Lievén, 1848; Smirnov 1992

**M. breviseta* Smirnov, 1976; Qld (Smirnov 1976); Vic. (Shiel 1981³); WA (Growth *et al.* 1992); ?NSW (Timms 1993)

M. capensis (Sars, 1916); *Echinisca capensis* Sars, 1916; Smirnov 1992; Vic. (Smirnov 1976); NSW (Shiel 1981³); Tas., WA (Smirnov & Timms 1983); Qld, NT (Timms 1988)

**M. carinata* (Smirnov, 1976); *Echinisca carinata* Smirnov, 1976; Smirnov (1992); Qld (Smirnov 1976); NSW, Tas., WA (Smirnov & Timms 1983)

**M. flabelligera* Smirnov, 1992; Qld (Smirnov 1992)

**M. flagellata* (Smirnov & Timms, 1983); *Echinisca flagellata* Smirnov & Timms, 1983; Smirnov 1992; Tas. (Smirnov & Timms, 1983)

**M. hardingi* Petkovski, 1973; *Echinisca hardingi*: Smirnov 1976; WA (Petkovski 1973b); NSW (Shiel 1981³)

M. hirsuticornis Norman & Brady, 1867; Vic. (Smirnov 1976); SA (Mitchell 1980⁶)

**M. hystrix* Gurney, 1927; Qld (Gurney 1927); NT (Julli 1986)

**M. indistincta* Smirnov, 1992; NSW, WA (Smirnov 1992)

**M. longiseta* Smirnov, 1976; Vic. (Smirnov 1976); "tropical Australia", Tas. (Smirnov 1992)

M. malayensis Idris & Fernando, 1981; Qld (Timms 1988)

**M. pectinata* (Smirnov, 1976); *Echinisca pectinata* Smirnov, 1976; Smirnov 1992; Qld, Vic. (Smirnov 1976); NSW (Smirnov & Timms 1983)

M. rosea (Lievén, 1848); *Echinisca rosea* Lievén, 1848; Smirnov 1992; Qld (Smirnov & Timms 1983)

M. schaanislandi Sars, 1903; *Macrothrix bursalis* Smith, 1909; Smirnov & Timms (1983); Tas. (Smith 1909); Vic., "tropical Australia" (Smirnov 1992)

M. spinosa King, 1853; NSW (King, 1853); Vic., SA (Shiel 1981³)

**M. timmsi* (Smirnov, 1976); *Echinisca timmsi* Smirnov, 1976; Smirnov 1992; NSW (Smirnov 1976); Qld (Timms 1986)

M. triserialis Brady, 1886; *Echinisca triserialis* Smirnov 1976; ?NSW (Henry 1922); Qld, Vic., SA (Smirnov & Timms, 1983); NT (Julli 1986); WA (Timms 1988)

**M. williamsi* (Smirnov & Timms, 1983); *Echinisca williamsi* Smirnov & Timms, 1983; Smirnov 1992; Qld (Smirnov & Timms 1983); NT (Julli 1986)

Neothrix Gurney, 1927

***N. armata* Gurney, 1927; Qld (Gurney 1927); Vic. (Morton 1973⁴); WA (Bayly 1982); NSW (Kobayashi 1992)

**N. paucisetosa* Smirnov, 1989b; *Macrothrix paucisetosa* Smirnov 1989b; WA (Smirnov 1989b)

**N. superarmata* Smirnov, 1989b; Qld (Smirnov 1989b)

***Pseudomoina* Sars, 1912

***P. lemnae* (King, 1853); *Moina lemnae* King, 1853; *Pseudomoina lemnae* Sars 1912; NSW (King 1853); Vic. (Shephard *et al.* 1918); Tas. (Smirnov & Timms 1983); SA (Shiel & Koste 1985)

⁶MITCHELL, B.D. (1980) The ecology of waste stabilization ponds. Ph. D. thesis, University of Adelaide, unpubl.

Streblocerus Sars, 1862

S. serricaudatus (Fischer, 1849); *Daphnia laicornis* Fischer, 1849; *Streblocerus serricaudatus* Lilljeborg, 1900; Smirnov 1976; Vic. (Smirnov 1976); Qld, Tas. (Smirnov & Timms 1983)

Family Moinidae Goulden, 1968*Moina* Baird, 1850

**M. australiensis* Sars, 1896; NSW (Sars 1896); Vic. (Shiel 1981³); WA (Smirnov & Timms 1983); NT (Tait *et al.* 1984)

**M. baylyi* Forrò, 1985; *Moina mongolica* Daday, 1901 in Bayly (1976), Smirnov (1976), Smirnov & Timms (1983) (misidentified); SA (Bayly 1976); NSW (Williams 1986); Qld (Timms 1987)

**M. flexuosa* Sars, 1897; WA (Sars 1897)

M. micrura Kurz, 1874; *Moina propinqua* Sars, 1885; Goulden (1968); *Moina dubia* Richard in Gurney (1927) (misidentified); Goulden (1968); Qld (Sars 1885); NSW (Timms 1970); Vic. (Timms 1973²); SA (Shiel 1978); NT (Smirnov & Timms 1983)

**M. tenuicornis* Sars, 1896; NSW (Sars 1896); Vic. (Henry 1922).

Comment: Possibly also from South Africa (unverified); Goulden (1968)

Moinodaphnia Herrick, 1887

M. macleayi (King, 1853); *Moina macleayi* King, 1853; *Moinodaphnia macleayi* Sars 1888; NSW (King 1853); Qld (Smirnov & Timms 1983); NT (Jull 1986); WA (Timms 1988)

Family Bosminidae Sars, 1865*Bosmina* Baird, 1845

B. meridionalis Sars, 1903 (not 1904 as in Smirnov & Timms [1983]).

For extensive synonymy, see Smirnov & Timms (1983). See also *Incertae sedis* below; Tas. (Smith 1909, as *B. roundata*); NSW (Jolly 1966); Qld (Timms & Midgley 1969); Vic. (Timms 1973²); SA (Shiel *et al.* 1982); NT (Tait *et al.* 1984); WA (Timms 1988)

Bosminopsis Richard, 1895

B. dietersi Richard, 1897; NSW (Jolly 1966); NT (Tait 1981); Qld (Timms 1986); WA (Timms 1988)

Family Daphniidae Straus, 1820*Ceriodaphnia* Dana, 1852

C. cornuta Sars, 1885; Qld (Sars 1885); NSW (Henry 1922); Vic. (Shiel 1978); NT (Tait 1981); SA (Shiel *et al.* 1982); Tas. (Koste & Shiel 1987); WA (Bernier 1987)

Comment: Evidently more than one small species of *Ceriodaphnia* with an acute "beak" occurs in tropical

Australia (cf. Bernier 1987). Until a thorough revision of the genus has been made, these taxa should be referred to *C. cornuta* s.l.

C. dubia Richard, 1894; Qld (Gurney 1927); Vic. (Shiel 1976); ?NSW (Timms 1989)

C. laicaudata Mueller, 1867; ?Vic. (Shiel 1978); ?Qld (Timms 1988)

C. quadrangula (Müller, 1785; *Ceriodaphnia hakea* Smith, 1909; Brehm (1953a); ?*Ceriodaphnia planifrons* Smith; Brehm (1953a); Tas. (Smith 1909); NSW (Jolly 1966); Vic. (Timms 1973²); SA (Shiel 1978)

C. rotunda Sars, 1862; Vic. (Shephard *et al.* 1918)

Daphnia Müller, 1785

D. carinata King, 1853 s.l. For extensive synonymy, see Benzie (1988: 136-139); NSW (King 1853); Vic. (Shephard 1898); Tas. (Shephard 1917); WA (Serventy 1929); Qld (Timms 1968); SA (Mitchell 1978); NT (Timms & Morton 1988)

D. cephalata King, 1853; For synonymy, see Benzie (1988: 129); NSW (King 1853); Vic. (Sars 1914)

**D. jollyi* Petkovski, 1973; WA (Petkovski 1973a)

D. lumholzi Sars, 1885; For synonymy, see Benzie (1988: 113-114); Qld (Sars 1885); NSW, Vic., SA (Shiel 1981³); WA (Timms & Morton 1988)

**D. nivalis* Hebert, 1978; For synonymy, see Benzie (1988: 122); NSW (Hebert 1977)

**D. occidentalis* Benzie, 1986; WA (Benzie 1986a)

Daphniopsis Sars, 1903

**D. australis* Sergeev & Williams, 1985; Tas. (Sergeev & Williams 1985); SA, Vic. (Williams 1986)

**D. pusilla* Serventy, 1929; WA (Serventy 1929); Vic., SA (Bayly & Edward 1969); Tas. (Sergeev & Williams 1983)

**D. quadrangulus* Sergeev, 1990; Vic. (Sergeev 1990a)

**D. queenslandensis* Sergeev, 1990; Qld (Sergeev 1990b)

Scapholeberis Schoedler, 1858

S. kingi Sars, 1903; *Daphnia mucronata* Müller, 1785; King 1853 (misidentification); *Scapholeberis kingii*: Sars, 1888 (*nomen nudum*); Smirnov & Timms 1983; *Scapholeberis kingi* Sars, 1903; NSW (King 1853); Vic. (Henry 1922); NT (Jull 1986); Qld (Timms 1988); WA (Halse *et al.* 1993)

Simocephalus Schoedler, 1858

S. acutirostratus (King, 1853); *Daphnia elisabethae acutirostrata* King, 1853; *Simocephalus acutirostratus*: Sars 1888; *Simocephalus dulvertonensis* Smith, 1909; Dumont in Smirnov & Timms 1983; NSW (King 1853); Vic. (Haase 1903); Tas. (Smith 1909); NT (Tait *et al.* 1984); Qld (Timms 1988)

- S. exspinosus australiensis* (Dana, 1852); *Daphnia australiensis* Dana, 1852; *Simoccephalus australiensis*: Sars, 1888; *S. exspinosus australiensis*: Dumont in Smirnov & Timms (1983); Qld (Sars 1888); NSW (Sars 1896); ?Tas. (Smith 1909); SA (Henry 1922); WA (Serventy 1929); Vic. (Morton 1973⁴).
- S. latirostris* Stingelin, 1906; ?*S. iheringi* Richard, 1897; Dumont in Smirnov & Timms (1983); ?NSW (Henry 1922); NT (Tait *et al.* 1984); Qld, WA (Timms 1988).
- S. serrulatus* (Koch, 1841); NT (Jull 1986); Qld (Timms 1988).
- S. vetulus* (Müller, 1776); 2 ssp. recognized from Australia (see comments by Dumont, in Smirnov & Timms [1983: 98-102]).
- S. vetulus elisabethae* (King, 1853); *Daphnia elisabethae* King; *Simoccephalus elisabethae*: Sars 1888; NSW (King 1853); Vic. (Shiel 1978); SA (Shiel 1981⁷); Qld, NT (Timms 1988).
- S. vetulus gibbosus* (Sars, 1896); *Simoccephalus gibbosus* Sars, 1896; *Simoccephalus vetulus gibbosus*: Dumont in Smirnov & Timms 1983; NSW (Sars 1896); Vic. (Shephard *et al.* 1918); SA (Shiel 1981³).
- **S. victoriensis* Dumont, 1983; Vic (Dumont in Smirnov & Timms 1983).

Incertae sedis

- Alona bairdii* King, 1853; NSW (King 1853): Description inadequate.
- Alona karua* King, 1853; NSW: *Biapertura karua* in Smirnov & Timms (1983) is erroneously referred to King. They list King's *Alona karua* as *incertae sedis*. The species they have mislabelled is *Alonella karua* in Sars (1888), which is apparently a misidentification of another species, not the nominate *A. karua*. As figured by Sars, it is clearly not the taxon figured by King, and should be relocated if King's species is rediscovered.
- Alona mascula* King, 1853; NSW: Inadequately described.
- Bosmina maritima* Müller, 1867; "off the Abrolhos, 300 miles north of Fremantle, Western Australia, in November, 1910" (Searle 1936: 172). Not recorded again, or mentioned by Korinek in Smirnov & Timms (1983). *B. maritima* is recorded as a synonym of *B. longispina* Leydig, 1860 in Flössner (1972). This is the only record of a marine bosminid from Australia and its identity is uncertain.
- Chydorus barroisi* (Richard, 1894); Qld (Smirnov 1971): = *Ephemeroporus barroisi*, *nomen dubium* (See Frey 1982a). Frey noted (p. 234) that the figured specimens from Prospect Reservoir NSW, in Smirnov (1971 Figs 328, 330, 331, 332) are not

conspecific with *E. tridentatus* (Fig. 329 in the same series), nor are they conspecific with *E. barroisi* s. str.

Chydorus hybridus Daday, 1905; Qld, NSW (Smirnov & Timms 1983): Frey (1982a) relocated *C. hybridus* s. str. to a new genus, *Ephemeroporus*, and the taxon became *E. hybridus* (Daday). The limited features of the Australian taxon assigned to "*C. hybridus*" as figured in Smirnov & Timms (1983) are neither *Chydorus* nor *Ephemeroporus*, but more correctly those of *Rak* (Frey, in MS).

Chydorus ovalis Kurz., 1874; NSW (Henry 1922): No figures or material are available of the taxon identified by Henry and it has not been recorded again. It is a Holarctic species and regarded as absent from Australia by Smirnov & Timms (1983).

Daphnia honorata King, 1853; NSW (King 1853): A species of *Ceriodaphnia*, inadequately described and figured. Sars (1888) considered it close to the European *C. reticulata* (Jurine, 1820), but specifically distinct.

Dunhevedia podagra King, 1853; NSW: Not seen since original description, which is inadequate.

Eurycerus cunninghami King, 1853; NSW (King, 1853): A chydorid, but not referable to *Eurycerus*.

Eurycerus spinosus King, 1853; NSW (King, 1853): A chydorid, but not referable to *Eurycerus*.

Pleuroxus aduncus (Jurine, 1820) in Smirnov & Timms (1983); *Alonella nasuta* Smith, 1909; *Chydorus denticulatus* Henry, 1919; *Chydorus anispinus* Henry, 1922; southern Australia: Smirnov & Timms (1983): These taxa were synonymized with the northern hemisphere *P. aduncus* by Smirnov & Timms (1983: 24). Frey (1991b), after examination of these and other extensive materials, considered that *P. aduncus* does not occur in Australia. The identities of these various taxa have yet to be resolved.

P. denticulatus Birge, 1879; non *Chydorus denticulatus* Henry, 1919; NSW (Smirnov 1971); Vic. (Timms 1973²); ?Qld, ?NT, ?WA (Timms 1988).

Comment: After examination of the available material in the Australian Museum labelled as *P. denticulatus*, Frey (1991b) concluded that none of the specimens was of the nominated taxon and they were certainly not conspecific. He considered that the species probably was absent from Australia.

Zoogeography

Our comments here must be considered preliminary, given the rapid changes in cladoceran taxonomy in recent years. Widespread recognition of non-cosmopolitanism has provided a significant impetus to a more critical approach (cf. Frey 1982b). It is clear, particularly from some of the last works of Frey (1991a, b), that a considerable degree of endemism is obscured

by cosmopolitan names in the Australian fauna. In our opinion, any cladoceran in Australia referred to a species described from the northern hemisphere should be viewed with suspicion until critical reviews of all families, to the standard of Frey (1991b), are achieved.

On present evidence, Australia has more cladoceran species: 165 vs ca. 120 (Europe) and 140 (U.S.A.) than are found in other comparable areas. Overall the level of endemism stands at 43%, with five additional taxa also known from New Zealand, i.e. Australasian endemism is ca. 46%. To the endemic genera *Neothrix*, *Pseudomoina* (Macrothricidae), *Archepleuroxus*, *Australochydorus*, *Monope*, *Rak*, *Rhynchochydorus* and *Savcia* (Chydoridae) listed by Smirnov & Timms (1983), *Celsinotum*, *Leberis*, *Planicirculus* and *Plurispina* (Chydoridae) are added.

Most radiation appears to have occurred in the Chydoridae: 45 of the 94 recognized species (48%) are endemic. Australia may differ from other regions in the selective pressures which cause genetic divergence (cf. Frey 1991b). In any event there has been marked speciation in areas where water is limited, e.g. southwestern W.A., where the habitats are not those 'normally' indicative or supportive of a diverse aquatic microfauna, e.g. rock pools, salinized wetlands. The

aquatic microfauna of these habitats, in common with those of billabongs and wetlands on the opposite side of the continent, have generally been ignored. We suspect that a diverse array of indigenous cladocerans is yet to be discovered.

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